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Bionanocomposites based on gelatin matrix and nanocellulose

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Abstract

Cellulose nanofibres (CNF) and nanocrystals (CNC) have been used to develop bionanocomposite films based on a protein matrix. Nanocrystals were isolated using different hydrolysis times which affect in CNC aspect ratio. For obtaining bionanocomposites films, solvent casting method was used. Fourier transform infrared spectroscopy (FTIR), Thermogravimetric analysis (TGA), Differential Scanning Calorimetry (DSC) and oxygen and water vapour permeability tests were carried out to analyse the effect of nanocellulose addition to gelatin matrix. Gelatin matrix and nanocomposites tensile properties and fractured surface morphologies were also studied. After the addition of nanocellulose to gelatin matrix tensile strength decreased because there is a lack of adhesion between nanocellulose and gelatin matrix. Nanocellulose contributes to improve the excellent oxygen gas barrier properties of gelatin. Gelatin T_g value depends on the water content and shifted to higher temperatures as water content decreases. The addition of nanocellulose also slightly shifted dry gelatin T_g to higher temperatures.

Keywords: nanocellulose, gelatin, bionanocomposite

1. Introduction

The environmental concern for reducing the dependence on fossil resources has boosted the use of renewable materials derived from animals or plants [25,30]. In addition, oil price increment is another important reason for the promotion of substitutes for synthetic plastics [25]. Biopolymers such as polysaccharides and polypeptides are considered the most promising candidates in many applications, particularly in biomedical and food packaging fields due to their biodegradability, abundance, sustainability and renewable nature [10,25].

In particular, gelatin biopolymer is a renewable protein obtained from the partial denaturation of native collagen present in the bones and skin of animals by a controlled hydrolysis reaction [9,17,23]. Like most proteins, gelatin has suitable film forming properties, excellent biocompability and adhesiveness, and presents good barrier against oxygen and aromas at low and intermediate relative humidity [21,23,25,31]. However, the use of gelatin in many applications is limited due to their poor mechanical properties [16]. One via to improve biobased polymeric matrix properties is the use of nanocellulose from renewable resources as nanoreinforcements. Cellulose nanofibres